Strain Effects on the Structural and Magnetic Properties of La-Ca-Mn-O Epitaxial Films, R. P. Vasquez, JPL, N.-C. Yeh and D. A. Beam, Caltech, M. C. Foote, JPL, Pasadena, CA

$La_{0.7}Ca_{0.3}MnO_3$ (a=3.86 Å) epitaxial thin films have been grown on $SrTiO_3$ (a=3.905 Å), $LaAlO_3$ (a=3.79 Å), and $YAlO_3$ (a/√2=3.66 Å, b/√2=3.77 Å) substrates. Films have been characterized with x-ray diffraction (XRD), x-ray photoernission spectroscopy (XPS), dc and ac resistivity, and dc magnetization measurements. XRD shows that the films are single phase, and the roeking curve widths are limited by the x-ray optics for all films, demonstrating the structural quality of the films. For films on $SrTiO_3$, with the films under tensile stress, c=3.86 Å, the same as the bulk value. For films on $LaAlO_3$ and $YAlO_3$, with the films under compressive stress, c=3.92 Å, suggesting tetragonal distortion of the lattice. Measurements for films on $LaAlO_3$ show a peak in resistivity near 130 K and a giant negative magnetoresistance ({ R(H)-R(0)}/R(H)- -350% for H = 6 T) for magnetic fields in the plane of the sample, as has also been reported in the literature. However, for films grown on a $PrBa_2Cu_3O_7$ buffer layer on $LaAlO_3$, the zero-field resistive peak occurs at a lower temperature of 110 K, and giant positive magnetoresistance ({R(H)-R(0)}/R(0) ~ +125% for H = 6 T) and a reduction in c to 3.87 Å are observed. Rotation of these films from parallel to perpendicular to the applied magnetic field up to 6 T shows no noticeable anisotropy in the magnetoresistance of both systems. In addition, no hysteretic behavior can be detected. XPS studies show no significant difference in the Mn^{+3}/Mn^{+4} ratio or valence band densities of states for all films measured. Compared to undoped samples, Ca doping lowers the binding energy of all of the core levels by 0.1-0.2 eV, consistent with a shift in the Fermi level. The valence bands do not exhibit clear Fermi edges at room temperature, consistent with the observed semiconducting resistivity behavior above the Curie temperature. Finally, the correlation between the lattice distortion and the transport as well as magnetic properties of films grown on different substrates will be discussed.